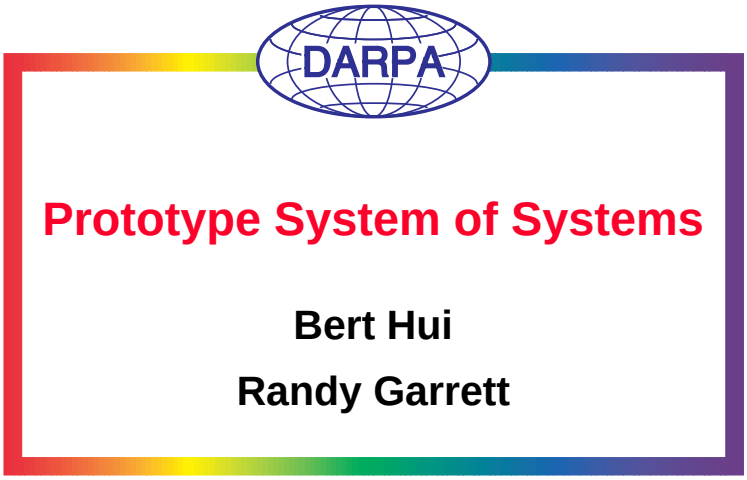
DARPA
Prototype System of Systems
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Prototype System of Systems

Program Goals

Develop a large-scale prototype system to enable survivable, real-time, application- independent access to and distribution of video, voice and data in a heterogeneous environment consisting of multiple networks and systems

	Existing Technology	PSOS Program
Access & Distribution of Information	Stove-piped information within systems Expensive and inadequate bandwidth (64 kb/s - 1.5 kb/s to end users) to support future multimedia applications	Information broadly shared across systems Affordable bandwidth to support new multimedia applications (minimum 155 Mb/s to end users)
Survivability of Information	DoD - inadequate for large scale systems Commercial - afterthought	Recipient of Information Survivability Program technology in a Red Team testbed
Management & Control of Information Environment	Operable only within a network Network and applications management are not integrated	Integrate anticipatory management and control among networks and among networks and applications

Today's networks are dominated by stovepiped systems. Each has its own management, control algorithms, protocols and vendor-specific equipment. As a result, communication among networks is difficult and in some cases almost impossible. However, the communication environment is increasingly distributive; a communications link may have to traverse over multiple networks. In addition, the communication content is not just voice anymore, but a combination of voice, data, imagery and video. The bandwidth requirement exceeds that of voice traffic by many orders of magnitude. It is therefore vital to develop the technologies to bring down these system-specific barriers so that networks, independent of their geographic span and locations, can communicate with each other efficiently. Also, the data pipes should be large and reasonably affordable so that multimedia services and applications can be transported among users. The Prototype System of Systems (PSOS) Program is created for this purpose.

In this heterogeneous environment, all layers must be worked on: physical, service and applications, to create this vision of system of systems. The resulting network should also be scalable to avoid becoming a stovepipe system by itself. Security is a very essential feature of this network. Technologies being developed by other programs will be used to enhance the survivability of this prototype system.

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Program Tasks

I. SuperNet

Develop multimedia access to end users over distributed, heterogeneous and very high-bandwidth environment with an integrated survivable management and control system

II. Seamless Link to Information (SLI)

Develop the middleware to draw information from multiple heterogeneous data sources to create a user-specified set of facts that with associated extrapolation and deduction tools will support commander's decision making

III. Experiments

Incrementally validate the PSOS environment through a step-by-step demonstration of key concepts and technologies

At the physical layer, there is a need to create a network of broadband links (SuperNet) to accommodate the bandwidth demanded by multimedia services and applications. Efficient gateways will be built to connect to multiple terrestrial and wireless testbeds. Multi-layer management and control algorithms based on object-oriented software will be developed to "unify" the isolated testbeds.

Moving up to the service layer, smart link middleware will be developed so that end users can assess the required information independent of the way the source data is created, formatted or stored. Moreover, the service manager will be sophisticated enough to deliver the appropriate amount and content to the end users without over burdening them.

Lastly, the management of the service layer and the application layer will be linked together to enable a high quality-of-service delivery of advanced applications. A number of experiments are planned to validate the technologies developed for the physical and service layers. In addition, technologies developed by other ITO programs like Information Survivability, Digital Libraries, Intelligent Collaboration, Information Management and Quorum will also be showcased in the PSOS testbed.

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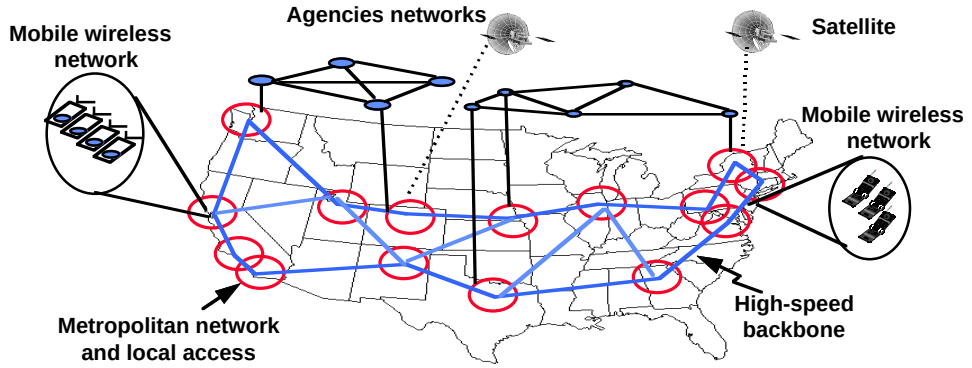
SuperNet



SuperNet sub-tasks

- Minimum 155 Mb/s to end users to support collaborative multimedia applications
- Very high speed backbone with WDM technology and optical switching
- Efficient, low-bit, error rate interfaces among terrestrial nodes, satellites and mobile wireless networks
- Deploy intrusion detection and other Information Survivability technologies in a large-scale system
- Integrated anticipatory management and control among networks

One of the major goals of SuperNet is to provide broadband connections to the end users to enable the next generation of services and applications. The processors in desktops can already operate over 100 MHz. To do collaborative applications with desktops in real time, comparable speed will be needed. Connection speed less than OC-3 is available readily from the carriers. Some OC-3 services are available in certain regions but are usually very expensive. One goal is to deliver affordable OC-3 service to the end users. Upgrading the backbone with switched WDM (wavelength-division-multiplexing) techniques can be accomplished by working with carriers. Broadband access technologies can be developed to lower the cost. Once the backbone is in place, today's isolated networks and testbeds can be connected through gateways. The necessary interfaces, network survivability technologies and management will also be put in place.

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SuperNet Issues

Tasks	Issues
155 Mb/s to end users	Cost (tariff rate > $100K/year)? Where? How many?
Very high-speed backbone and switching	Cost? Survivable architecture? Is the BIT technology adequate?
Efficient interfaces	TCP/IP or ATM? Variable packet size? Flow control?
Survivability of information	Are the technologies from Information Survivability Adequate? Policies? Red Team/defensive strategy?
Management and control	Interoperability and complexity?
Others	Cross agencies collaboration and cost share? Industry collaboration and cost share?

The major issues will be the cost of the connections and cross-agency collaborations. Cost sharing with industry and by other agencies is expected to make this program affordable.

On the technical side, network interoperability and system complexity will be the major concerns.

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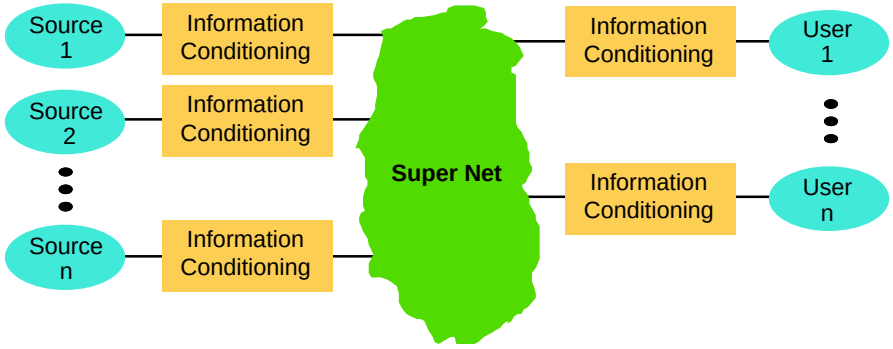
Seamless Link to Information (SLI)



PSOS SLI sub-tasks

- Provide application-independent interfaces for configuration, filtering and caching
- Correlate, encrypt, decode and support other conversions of real time heterogeneous data into user specified information
- Integrate anticipatory management and control among networks and applications
- Deploy Information Survivability Technology into the SLI

Future DoD information systems must provide services that adapt to the needs and preferences of warfighters rather than constrain warfighters to adapt to the underlying components. Warfighters must be able to craft their own tailored environment to meet their current mission. PSOS will strive to establish an information environment that will provide multimedia access to information to end users over a distributed, heterogeneous and very high-bandwidth environment with an integrated, survivable management and control system.

Middleware (information conditioning) will likely be used to draw information from multiple heterogeneous data sources to create a user-specified set of facts that with associated extrapolation and deduction tools will support commanders' decision making. In conjunction with the ability to rapidly compose tailored environments, all components of the system should be secure and resilient to Information Warfare assaults. Software and hardware diagnostics should also be an integral part of the components so that the reliability of very large-scale systems will be enhanced. Similarly, all components should support application-level management functions, so that the applications themselves can dynamically adjust to changes in system resources such as bandwidth constraints, increased network latency, or diminished computer cycles to provide the best quality of service possible within the new constraints.

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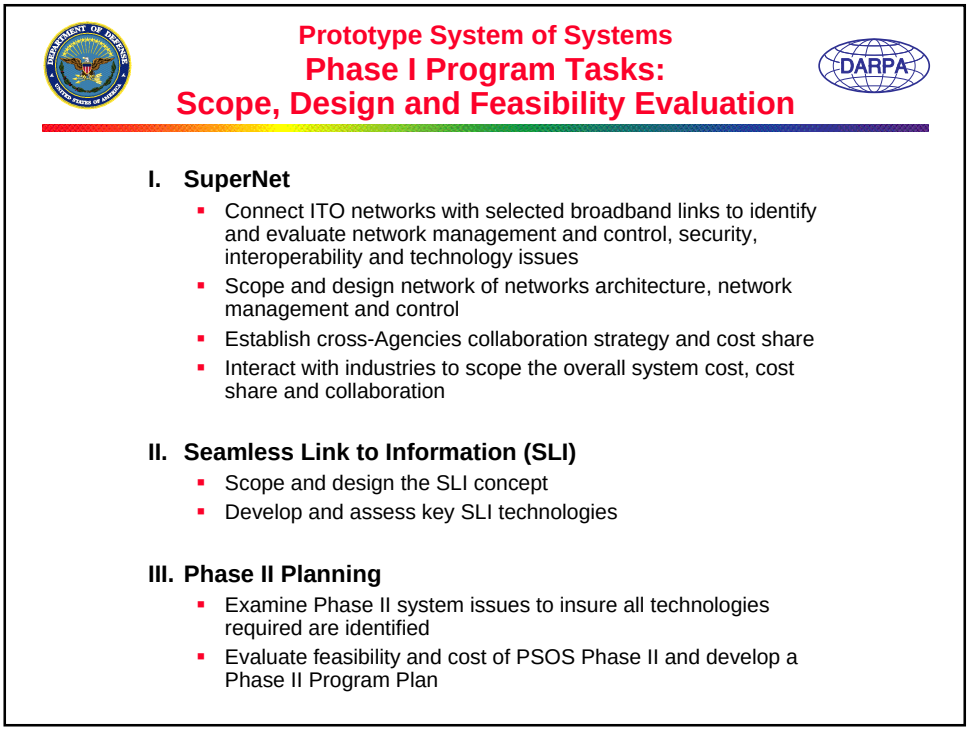
SLI Issues

Sub-tasks	Issues
Provide application-independent interfaces for configuration, filtering and caching	Can efficient mediated links be developed which will scale to large numbers of high-speed sensor feeds and other high-volume sources of data?
Correlate, encrypt, decode and support other conversions of real-time heterogeneous data into user-specified information	Can information content be communicated across heterogeneous systems independent of the original source or expected user ?
Integrate anticipatory management and control among networks and applications	Can integration of the network and application management be achieved in a large-scale system?
Deploy Information Survivability technology into the SLI	Are the technologies from the Information Survivability Program adequate? Policies? Red Team/defensive strategy?

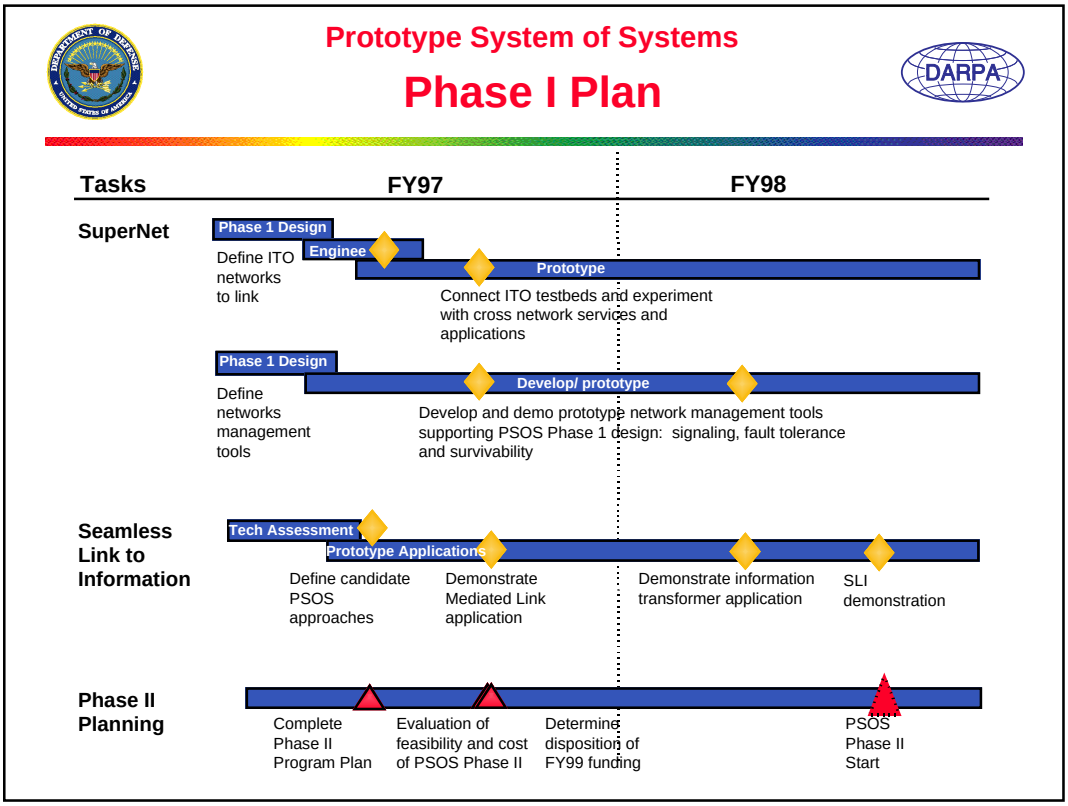
Over the next 6-12 months, Phase I, these general issues and many more will be explored, expanded and researched in an attempt to characterize and scope the specific technology challenges facing PSOS. The issues and research undertaken will support the broad goal of providing an information environment comprising a dynamic, adaptive, set of mechanisms, services, facilities, and value-added functions that enable information and knowledge to be developed and exchanged among users and producers.



The program is divided into two phases. In Phase I, which lasts for 2 years starting in FY97, some ongoing ITO testbeds and ITO supported locations will be connected together to understand some of the network management, security, interoperability and technology issues. Some cross-agencies agreement and collaboration efforts will be diligently worked on. The industries to solicit input, collaboration and cost sharing will also be contacted.

On the Seamless Link effort, initial design concepts to assess key SLI technologies will be prototyped.

Commencement of Phase II will depend on the success of Phase I.



Early prototypes will illustrate the viability and utility of key PSOS technologies.

The decision, whether or not to continue with Phase II, will be made in late Spring 1997.

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Phase I Milestones

SuperNet

2Q97 Report on cross-Agencies collaboration strategy and cost share
2Q97 Report on industry partnerships and cost share
3Q97 Report on network management and control and security strategy
3Q97 Connection of selected ITO networks
2Q98 Evaluate WDM and optical switching

Seamless Link

2Q97 Report on PSOS-related technologies
3Q97 Demonstrate a Mediated Link application
2Q98 Demonstrate an information transformer application
3Q98 Conduct a SLI integrated demonstration

Phase II Planning

2Q97 Complete Phase II Program Plan
3Q97 Evaluate Phase II feasibility and cost
3Q97 Determine disposition of FY99 funding
3Q98 Initiate Phase II

These milestones are important steps towards making a Phase II program decision.

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PSOS Transition Strategy

Dual-Use Approach: establish early adoption of this technology by the Services and the industry; leverage commercial development to reduce cost

DoD:

- Team with Services and other Agencies to incorporate specific requirements in security, management and control
- Joint demonstrations with Services and Agencies to validate system concepts and capabilities
- Set up MOUs or MOAs with Services and Agencies for transition

Industry:

- Cost share with industry consortia to gain early commitment and acceptance
- Open standards to encourage commercialization
- Encourage industry to participate as real “users”, not as contractors, to experiment with services, applications and billing

The distributed, heterogeneous nature of PSOS requires extensive involvement with the Services, industry, and other Agencies to assure widespread use over a broad spectrum of requirements.